

Course Unit	Advanced Separation Processes	Field of study	Chemical Engineering Processes
Master in	Chemical Engineering	School	School of Technology and Management
Academic Year	2025/2026	Year of study	1
Type	Semestral	Semester	1
Level	2-1	ECTS credits	6.0
Code	6362-756-1105-00-25		
Workload (hours)	162	Contact hours	T 30 TP - PL 30 TC - S - E - OT - O -

T - Lectures; TP - Lectures and problem-solving; PL - Problem-solving, project or laboratory; TC - Fieldwork; S - Seminar; E - Placement; OT - Tutorial; O - Other

Name(s) of lecturer(s) José António Correia Silva

Learning outcomes and competences

At the end of the course unit the learner is expected to be able to:

1. Analyze and design multicomponent distillation columns by approximate methods: Fenske-Underwood-Gilliland Method (FUG)
2. Analyze and design multicomponent distillation using free commercial software ChemSep
3. Understand enhanced distillation: extractive distillation, azeotropic distillation, reactive distillation
4. Analyze and design separation processes with membranes
5. Analyze and design separation processes by adsorption, ion-exchange and chromatography

Prerequisites

Before the course unit the learner is expected to be able to:
Dominate basic concepts of thermodynamics, heat and mass transfer

Course contents

Multicomponent distillation (FUG method). Application of ChemSep software for multicomponent distillation. Enhanced distillation and supercritical extraction. Membrane separations. Adsorption processes.

Course contents (extended version)

1. Multicomponent distillation
 - Fenske-Underwood-Gilliland Method
2. Application of software ChemSep in the project of multicomponent distillation
3. Enhanced Distillation and Supercritical Extraction
 - Use of Triangular Graphs
 - Extractive Distillation
 - Salt distillation
 - PSA distillation
 - Azeotropic distillation
 - Reactive distillation
4. Membrane Separations
 - Types of membranes
 - Membrane modules
 - Gas Separation
 - Dialysis
 - Reverse Osmosis
5. Separation by adsorption, ion exchange and chromatography
 - Adsorbents
 - Adsorption equilibrium
 - Kinetics of sorption
 - Adsorptive systems: PSA, TSA and SMB

Recommended reading

1. J. D. Seader, Ernest J. Henley, D. Keith Rope; Separation Process Principles: With Applications Using Process Simulators, John Wiley & Sons, 4th Edition, 2016. ISBN: 978-1-119-14129-7
2. Christie John Geankoplis; Transport Processes and Separation Process Principles (Includes Unit Operations); Pearson, Fourth Edition 2013. ISBN-13: 978-0131013674
3. Philip C. Wankat; Separation Process Engineering: Includes Mass Transfer Analysis; Pearson, Fourth Edition, 2016. ISBN 13: 9780133443653

Teaching and learning methods

Theory: Description of theoretical concepts Practice: Discussion of course materials and homework assignments

Assessment methods

1. Alternative 1 - (Regular, Student Worker) (Final)
 - Intermediate Written Test - 30% (Week 5)
 - Intermediate Written Test - 30% (Week 10)
 - Intermediate Written Test - 40% (Week 15)
2. Alternative 2 - (Regular, Student Worker) (Final, Supplementary, Special)
 - Final Written Exam - 100%

Language of instruction

1. Portuguese
2. English

Electronic validation

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29-09-2025	06-10-2025	10-10-2025	01-11-2025